INDOOR AIR QUALITY ASSESSMENT

New Memorial Elementary School
2 Fiske Avenue
Upton, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
Emergency Response/Indoor Air Quality Program
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Background/Introduction

At the request of the Upton Board of Health, the Bureau of Environmental Health Assessment (BEHA) of the Massachusetts Department of Public Health (MDPH) provided assistance and consultation at the New Memorial Elementary School (NMES), 2 Fiske Avenue, Upton, Massachusetts. At the time of the assessment, the building was under construction. This request for an indoor environmental assessment was prompted by reports of water damage to interior walls, which are constructed from gypsum wallboard (GW).

On August 15, 2003, a visit to conduct an indoor air quality assessment was made to this school by Michael Feeney, Director of the Emergency Response/Indoor Air Quality (ER/IAQ) program, BEHA. Mr. Feeney was assisted by Cory Holmes, an Environmental Analyst in the ER/IAQ program. Mr. Feeney and Mr. Holmes were accompanied by David Dewhurst, Project Superintendent, P.J. Stella Construction Corp.; Michael Torres, Mount Vernon Group Architects; Marsha Paul and A. Rick Binaco of the Upton Board of Health and Bill McCormick, Upton Building Commissioner.

The NMES is a three-story brick building constructed on a cement slab. The new building is adjacent to the original Memorial School. School construction began in June 2002 and is scheduled for completion in December 2003. While the building is under construction, classes are being held at another building in a neighboring town. According to Mr. Dewhurst and town officials, gypsum wallboard (GW) had become water damaged due to roof leaks during the heavy rains of late May and early June 2003. Soon after, two consultant firms were hired to assess indoor air quality and inspect the water-damaged GW.

An initial evaluation for biological and moisture contamination was conducted in the building by an environmental consultant, Environmental Health, Inc. (EHI), during June 2003.

EHI conducted air sampling of wall cavities. Based on their assessment, EHI made the following recommendations:

- remove wet/mold colonized GW in sections 2 feet above floor level;
- remove insulation and other wet building materials;
- dry wall cavities;
- measure moisture levels of GW;
- treat wet/moldy studs and other non-porous materials with a biocide or bleach/water;
- install GW up to an inch off the floor to prevent future wicking; and
- identify and remove materials that are causing the "animal urine" odor on the second floor (EHI, 2003).

A second environmental consultant firm, OccuHealth, Inc. (OccuHealth), conducted an independent survey and review of the EHI findings. The OccuHealth report made the following recommendations:

- remove water damaged materials; and
- continue with scheduled removal of water GW in two areas found to be water damaged (OccuHealth, 2003).

According to OccuHealth, no further work to identify and remove microbial growth would be necessary.

At the time of the BEHA assessment, recommendations from both firms had been followed. Leaks were repaired and sections of GW had been replaced in a large number of areas.

Methods

Visual observation of building materials for water damage and mold growth was conducted. Water content of GW was measured with Delmhorst, BD-2000 Model, Moisture Detector with a Delmhorst Standard Probe. Air tests for temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551. Test results are shown in Table 1.

Results/Discussion

The building was evaluated following several weeks of moderate to heavy rainfall, on a day with an outdoor temperature of 86^{o}F and relative humidity of 50 percent. Temperatures measured in the school ranged from 80^{o}F to 82^{o}F. Relative humidity indoors was measured in a range of 54 to 64 percent in various areas of the school.

The following conditions concerning water penetration were noted:

- no roof leaks were observed, nor were further leakages reported since roof leaks responsible for the water penetration were reportedly eliminated;
- no visible mold growth or associated odors were detected during the assessment;
- no pooling water or evidence of pooling water (staining pattern) was noted on floors; and
- no signs of water damage were observed on GW, ceiling tiles, wooden cabinets, baseboards and floors, with one minor exception (some sagging paint above windows near the ceiling in room A-206).

As previously discussed, town officials were concerned with mold growth. In order for building materials to support mold growth, a source of water exposure is necessary. It is necessary to identify and eliminate the water source moistening building materials in order to

control mold growth. In addition to conducting a visual inspection, moisture content measurements are obtained to identify GW with increased moisture. Moisture content over normal concentrations may indicate possible presence of mold growth. Identification of the location of GW with increased moisture levels can also provide clues concerning the source of water supporting mold growth.

BEHA staff conducted moisture measurements of GW in areas with documented water damage. For comparison purposes, moisture measurements were also taken from areas that were not reported to be water damaged. The Delmhorst probe is equipped with three lights as visual aids to determine moisture level. Readings which activate the green light indicate a sufficiently dry moisture level (0 - 0.5%), those that activate the yellow light indicate slightly moist to borderline conditions (0.5 – 1.0%) and those that activate the red light indicate elevated moisture content (> 1%). GW had measurable moisture levels, ranging from 0.1 to 0.6 percent, in areas where water damage was reported. These results were similar to measurements taken in areas that were not identified as water damaged (Table 1).

Remediation of mold contaminated GW with an antimicrobial agent is not recommended. BEHA personnel have previously consulted with Dr. Harriet Burge, Adjunct Senior Lecturer of Environmental Microbiology in the Department of Environmental Health at the Harvard School of Public Health, about concerns of mold contamination in GW. According to Dr. Burge, the reoccurrence of mold growth after the application of bleach is common. Bleach consists of sodium hypochlorite in a 5 percent concentration mixed with water. When applied to moldy GW, the water of the bleach solution penetrates into the moldy GW, but the sodium hypochlorite remains on the surface of the GW. The sodium hypochlorite disinfects mold that it comes in contact with on the GW surface, but not the mold beneath the surface. The water added to the

subsurface mold fuels a spurt in growth, which increases mold colonization of the GW. As a result, mold colonies appear on the surface of treated GW shortly after application of bleach (Burge, 1999).

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Mold colonized GW cannot be adequately cleaned to remove mold growth. As discussed previously, GW in a number of areas was replaced throughout the building where water damage occurred.

Conclusions/Recommendations

In view of the findings at the time of the inspection, the following recommendations are made:

1. Continue to monitor for building envelope leaks (roofs, wall junctions, door frames and windows). Remediate leaks as necessary.
2. Should additional damage occur, remediate mold contaminated building materials in a manner consistent with *Mold Remediation in Schools and Commercial Buildings* published by the US Environmental Protection Agency (US EPA) (US EPA, 2001). Copies of this document can be downloaded from the US EPA website at: http://www.epa.gov/iaq/molds/mold_remediation.html.
3. Consider adopting the US EPA document, "Tools for Schools", in order to maintain a good indoor air quality environment in the building. The document can be downloaded from the Internet at http://www.epa.gov/iaq/schools/index.html.

4. For further building-wide evaluations and advice on maintaining public buildings, see the resource manual and other related indoor air quality documents located on the MDPH's website at http://www.state.ma.us/dph/beha/iaq/iaqhome.htm.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

Burge, Harriet. 1999. Personal Conversation with Dr. Harriet Burge, Harvard School of Public Health. December 13th, 1999.

EHI. 2003. Environmental Health Inc. Report RE: Mold in Walls-Memorial School, Upton, MA. Dated June 25, 2003.

OccuHealth. 2003. OccuHealth Inc. Letter to Joe Stella, P.J. Construction Corp. from Thomas Hamilton, CIH, RE: Upton Memorial School, Mold and Moisture Evaluation. Review of Consultant's Report on Mold in Walls. Dated July 16, 2003.

US EPA. 2001. *Mold Remediation in Schools and Commercial Buildings*. Office of Air and Radiation, Indoor Environments Division, Washington, DC. EPA 402-K-01-001. March 2001.

Table 1
New Memorial Elementary School, August 15, 2003
Gypsum Wallboard (GW) Moisture Content Sampling Results

Room Number	Temp (^{o} F)	Relative Humidity (%)	Range of Measured GW Moisture Concentration (%)* North	Range of Measured GW Moisture Concentration (%)* East	Range of Measured GW Moisture Concentration (%)* South	Range of Measured GW Moisture Concentration (%)* West
Background (Outside)	86	49				
A 318	82	54	0.4-0.6	0.4	0.4	0.4
A 319	81	54	0.4	0.4	0.4	0.4
3rd Floor Elec. Room	81	58	0.4-0.6	0.4	0.4-0.5	0.4-0.5
A 320	81	58	0.4	0.3-0.4	0.4-0.5	0.4-0.5
A 301	82	56	0.3-0.5	0.4-0.5	0.4	0.3-0.5
A 309	81	56	0.3-0.5	0.4-0.5	0.3-0.4	0.3-0.4
A 306	82	56	0.3-0.5	0.3-0.5	0.3-0.5	0.3-0.5
A 304	81	56	0.3-0.5	0.3-0.5	0.3-0.5	0.3-0.5
A 303	82	55	0.3-0.5	0.3-0.5	0.3-0.5	0.1-0.5
B 303	81	56	0.4-0.5	0.2-0.6	0.4-0.5	0.4-0.5
B 302	81	58	0.3-0.5	0.2-0.5	0.2-0.3	0.4-0.5
3rd Floor Hallway (B 301)	82	56			0.3-0.5	
3rd Floor Hallway Below Window	81	58		0.4-0.5		
Media Center	82	58	0.4-0.6	0.4-0.5	0.4	0.4
A 206	82	59	0.3-0.5	0.2-0.4	0.4-0.5	0.1-0.5
A 131	80	64	0.3-0.7	0.6-0.7	0.4-0.5	0.3-0.4
A 128	81	64	0.5-0.6	0.5-0.6	0.6-0.7	0.5-0.6

*Moisture content sampling of GW in rooms conducted at 6", 1" and 3" on North South East and West walls unless indicated